TECHNICAL DRAINAGE STUDY

for

Golden Valley Ranch

Mohave County, AZ

Prepared for:

Rhodes Homes Arizona, LLC.

2215 Hualapai Mountain Rd., Suite H

Kingman, Arizona 86401

Stanley Consultants INC.
A Stanley Group Company
Engineering, Environmental and Construction Services - Worldwide

Technical Drainage Study

For

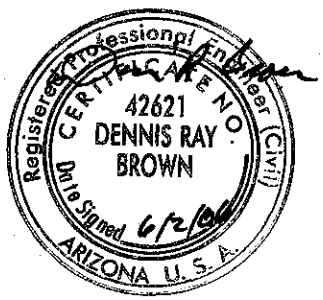
Golden Valley Ranch
Mohave County, AZ

October 2005
Revised June 2006

SCI Project # 18449.00.00

Prepared for:

Rhodes Homes Arizona, LLC.
2215 Hualapai Mountain Road, Suite H
Kingman, Arizona 86401



Prepared By:

STANLEY CONSULTANTS, INC.
5820 South Eastern Avenue, Suite 200
Las Vegas, Nevada 89119
(702)369-9396
Fax (702)369-9793

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Appendix A Reconnaissance Photos (photos taken December 07, 2004)

Appendix B Hydrology
HEC-HMS Regional Analysis – Results Junctions A - Q
Green-Ampt Shed Parameters
Green-Ampt Soil Association – XKSAT
ADOT – Composit Values of PSIF & Dtheta
Precipitation Distributions
Time of Concentration Worksheet
Muskingum Routing Worksheet

Appendix C Hydraulics
HEC-RAS Diversion Channel Analysis for the Holy Moses Wash
HEC-RAS Analysis for Holy Moses Diversion Wash 1 – Base Flood Elevation (BFE)
Normal Depth Street Capacity Analysis
Normal Depth Channel Analysis
Culvert Analysis

Appendix D Worksheets
HEC-HMS Local Analysis – Results Junctions J-N5, J-S26, & J-MG1
Shed and Routing Parameters (Junctions J-N5 & J-MG1)
Areas 1 -3 Tables and Exhibits (Appendix A from Technical Drainage Analysis, Areas 1-3)

Appendix E Indirect Methods – Discharge Verification

Appendix F Plans - Not Included with this Study (See Grading Plans this Project)

1. GENERAL LOCATION AND DEVELOPMENT DESCRIPTION

1.1. Introduction

This study is submitted as the technical drainage study for the proposed grading operations of the Golden Valley Ranch residential development located in the Sacramento Valley of Mohave County, Arizona. The project consists of approximately 5,800 acres of land located on the south side of the Golden Valley Community, near Kingman, Arizona. The valley is bordered by the Cerbat Mountains on the east and the Black Mountains on the west with the project site being located south of Hwy 68 and west of Interstate 40. Figure 1 – Vicinity Map and Regional Drainage shows the general vicinity of the project in relation to Mohave County, Arizona and the drainage shed boundary.

The site is in the direct path of several large washes. Approaching the property from the north, the Thirteen Mile Wash converges in the northwest corner of the site and flows in a southerly direction. The Cerbat Wash, located west of the Thirteen Mile Wash, joins with the Thirteen Mile Wash along its northern boarder. The Sacramento Wash crosses the southwest corner and joins with the Thirteen Mile Wash and the Holy Moses Wash south of the site. Located east of the site, the Holy Moses wash diverges into three distinct channels, one branch flows south without affecting the property and another branche crosses the site flowing east to west. The third branch flows northwest, crossing Aztec Road and converging with the Thirteen Mile Wash north of the property. The main channel passes through the site, also combining with the Thirteen Mile Wash.

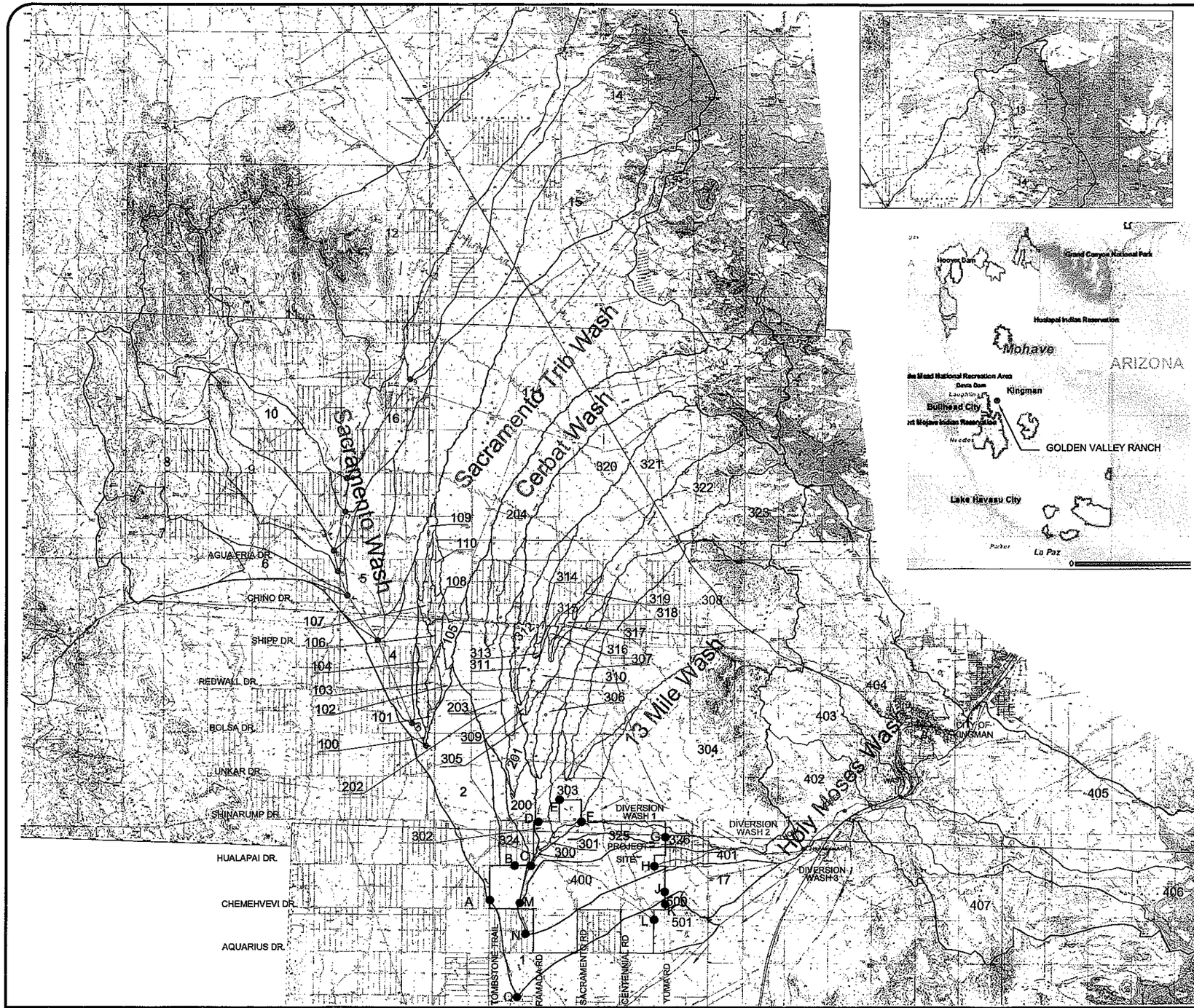
The purpose of this study is to evaluate the influence of existing drainage patterns on the proposed site development, to analyze the conveyance of runoff flows through the site, and to evaluate the change in runoff generated by varying land use from pre development to post development conditions.

This study is divided into four separate areas of consideration. They are as follows:

- A generalization (Regional Analysis) of the overall drainage area characteristics and associated runoff for the regional area affecting the 5800 acre development site
- A detailed analysis of the Holy Moses Wash and its impact on the eastern sections of the project.
- A general description of the specific development areas consisting of Areas 1, 2, and 3 or the initial phases of the project. A detailed study and phasing plan of each Area is developed in the individual Technical Drainage Study of that area.
- A determination of the Base Flood Elevations within the Holy Moses Diversion Wash #1.

1.2. Location

The project site consists of Taxpin Numbers 215-01-048, 215-01-075, 215-01-078, 215-01-079, 215-01-080, 215-01-084, 215-01-085, 215-01-092, & 215-15-005 within Township 20 North, Range 18 West and Township 21 North, and Range 18 West, G&SRM, Mohave County, Arizona (Figure 1 - Vicinity Map and Regional Drainage Scheme).



NORTH

GRAPHIC SCALE

(IN FEET)
1 inch = 8000ft.

Junction Flow			
Junctions/Nodes	100-yr, 24-hr (cfs)	100-yr, 6-hr (cfs)	Area (sq mi)
A	13980		134.0
B		390	1.1
C	12500	6230	71.0
D	3020	1870	16.9
E	3940	2710	20.0
F		5720	13.8
G		230	0.4
H	4120	4070	58.4
J		1120	2.1
K		140	0.1
L		730	1.1
M	15560	11780	72.8
N	11950		134.5
Q	21490		275.0

	Main Channel Flow (cfs)	Diverted Channel Flow (cfs)
J-HolyMosesA-01	9804	
DiversionWash 3	5229	4373
Diversion Wash 2	4141	1088
Diversion Wash 1	4030	111

SHED FLOW 100 yr - 24hr			
	Sacramento Sheds	Runoff (cfs)	Area (sq mi)
1	SacWashA-01	883.82	4.44
2	SacWashA-02	1260.14	4.807
3	SacWashA-03	155.1	0.4226
4	SacWashA-04	633.33	2.1252
5	SacWashA-05	982.5	3.2534
6	SacWashA-06	382	1.0804
7	SacWashB-01	1972.61	5.3076
8	SacWashA-07	2273.59	9.9401
9	SacWashA08	1258.58	5.193
10	SacWashA-09	1756.84	10.2545
11	SacWashA-11	3839.49	13.9298
12	SacWashA-12	2940.76	18.2366
13	SacWashC-01	1250.71	10.3994
14	SacWashC-02	1341.96	9.6207
15	SacWashD-01	1714.11	14.1515
16	SacWashA-10	725.79	2.7732
17	SacWashE-01	832.76	2.0957
	Sacramento Tributary 06		
100	SacTrib6-01	15.93	0.0269
101	SacTrib6-02	39.75	0.0516
102	SacTrib6-03	82.76	0.2335
103	SacTrib6C-01	130.17	0.2913
104	SacTrib6misc-01	197.09	0.6352
105	SacTrib6-04	147.7	0.42
106	SacTrib6C-02	133.64	0.1627
107	SacTrib6D-01	111.31	0.2913
108	SacTrib6C-03	139.34	0.2074
109	SacTrib6D-02	164.23	0.4351
110	SacTrib6C-04	114.84	0.2516
111	SacTrib6-05	2553.68	19.5342
	Cerbat Sheds		
200	Cerbat-01	309.48	0.9269
201	CerbatTrib1A-01	280	0.5265
202	Cerbat-02	641.9	3.6691
203	CerbatTrib1A-02	201.48	0.8467
204	cerbat-03	1391.97	10.083
	13Milewash Sheds		
300	13MileWash-01	13.72	0.0215
301	13MileWashC-01	16.57	0.0375
302	13MileWash-02	170.48	0.7907
303	13MileWashC-02	479.21	1.7953
304	13MileWashCmisc-01	2675.41	13.8256
305	13MileWashB-01	102.36	0.4188
306	13MileWash-03	302.7	1.5852
307	13MileWashC-03	274.8	1.1533
308	13MileWashCmisc-02	2463.74	11.6593
309	13MileWashB-02	39.67	0.057
310	13MileWashB-1A-01	207.52	0.5987
311	13MileWashB-03	172.09	0.3592
312	13MileWashA-01	227.89	1.2026
313	13MileWashB-1B-01	42.86	0.0439
314	13MileWashB-1B-02	55.3	0.0675
315	13MileWashB-04	24.65	0.0449
316	13MileWashB-1C-02	52.33	0.0593
317	13MileWashB-1C-01	54.12	0.1147
318	13MileWashB-1A-02	73.01	0.1641
319	13MileWashB-1A-03	66.76	0.1314
320	13MileWashA-02	941.2	4.8114
321	13MileWashB-05	1302.95	6.4186
322	13MileWash-04	843.06	4.2919
323	13MileWashC-04	1181.9	5.3401
324	13MileWashE-01	385.5	1.0617
325	13MileWashE-02	62.07	0.357
326	13MileWashE-03	153.59	0.357
	HolyMoses		
400	HolyMosesA-01	636.34	3.3
401	HolyMosesA-02	494.7	1.2150
402	HolyMosesA-03	1139.67	3.8747
403	HolyMosesA-05	1010.7	4.2697
404	HolyMosesA-07	2315.89	13.3273
405	HolyMosesA-08	3074.74	19.2803
406	HolyMosesA-06	1562.96	8.148
407	HolyMosesA-04	1447.28	8.2644
	Offsite Sheds		
500	Offsite Diverted-02	143	0.1181
501	Offsite Diverted-01	728	1.1335

LEGENDS:
- MAJOR SHED
- SUB SHED
- 204 SUB SHED LABEL
- JUNCTION / NODES
- GOLDEN VALLEY RANCH BOUNDARY
- BOLSA DR MAJOR ROADWAY
- DIVERSION WASH FLOW

Stanley Consultants INC.
5820 S. EASTERN AVENUE, SUITE 200
LAS VEGAS, NEVADA 89119 (702) 369-9396

GOLDEN VALLEY SOUTH
VICINITY MAP AND REGIONAL DRAINAGE SCHEME
TECHNICAL DRAINAGE STUDY EXHIBIT

MOHAVE COUNTY ARIZONA

FIGURE 1

Q:\18449\Drainage Study\Exhibits\Figure1_Exhibit.dwg, 6/1/2006 2:29:50 PM, \\vg-ps1\hp5500-tr-ps

1.3. FEMA Flood Hazard Zone

Figure 2 is a representation of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for Mohave County, AZ, map number 040058 2325C, dated October 20, 2000. Table 1 summarizes the Special Flood Hazard Zones (SFHA) within the site.

Table 1 - Golden Valley Flood Zone Summary

Location			ACREAGE IN ZONE		Sum of Acres
Township	Range	Section	A	C	Grand Total
20	18	2	37.5031	566.3706	603.8737
		3	85.2553	569.7779	655.0332
		4	283.924	370.8773	654.8013
		8	331.975	303.0097	634.9847
		9	229.3796	410.8725	640.2521
		10	93.0745	543.3179	636.3924
		11	63.6335	564.6344	628.2679
		14	4.0544	468.6927	472.7471
		16	316.629	323.7024	640.3314
		22	0	311.6559	311.6559
Total			1445.428	4432.911	5878.3397
21	18	34	73.6196	140.7216	214.3412
Grand Total			1519.048	4573.633	6092.6809

These SFHA zones are described as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations (BFE's) or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.

Zone AE and A1-A30

Zones AE and A1-A30 are the flood insurance rate zones that correspond to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, BFE's derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding with a constant water-surface elevation (usually areas of ponding) where average depths are between 1 and 3 feet. The BFE's derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

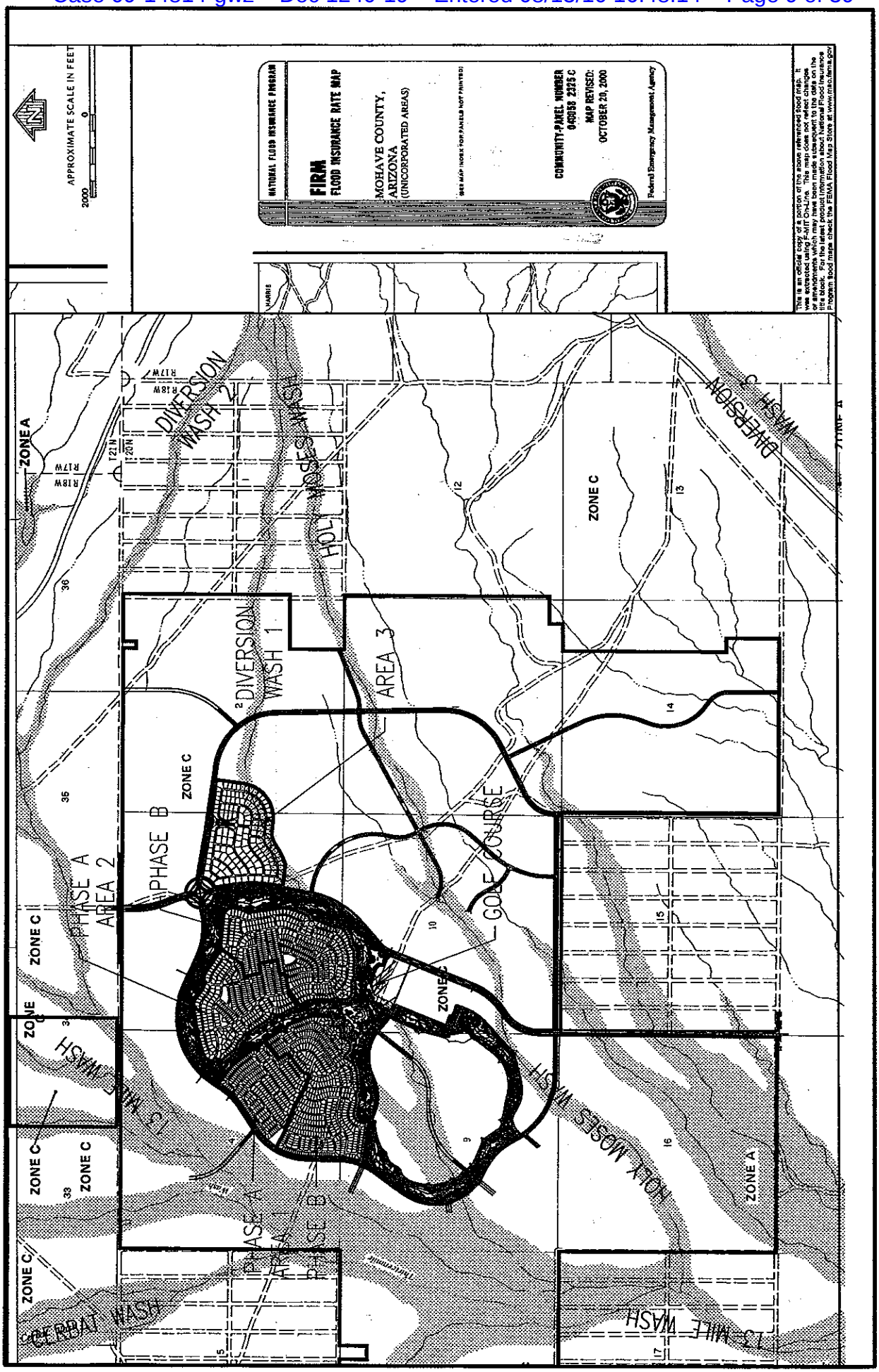


FIGURE 2
FEMA Flood Zones

Q:\18449\Drainage Study\Exhibits\Figure 2 FEMA.dwg, 6/1/2006 11:35:51 AM, \\lvg-ps1\hp5500-tr-ps

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet.

The depth should be averaged along the cross section and then along the direction of flow to determine the extent of the zone. Average flood depths derived from the detailed hydraulic analyses are shown within this zone. In addition, alluvial fan flood hazards are shown as Zone AO on the FIRM. Mandatory flood insurance purchase requirements apply.

Zone AR

Zone AR is the flood insurance rate zone used to depict areas protected from flood hazards by flood control structures, such as a levee, that are being restored. FEMA will consider using the Zone AR designation for a community if the flood protection system has been deemed restorable by a Federal agency in consultation with a local project sponsor; a minimum level of flood protection is still provided to the community by the system; and restoration of the flood protection system is scheduled to begin within a designated time period and in accordance with a progress plan negotiated between the community and FEMA. Mandatory purchase requirements for flood insurance will apply in Zone AR, but the rate will not exceed the rate for unnumbered A zones if the structure is built in compliance with Zone AR floodplain management regulations. For floodplain management in Zone AR areas, elevation is not required for improvements to existing structures. However, for new construction, the structure must be elevated (or flood proofed for non-residential structures) such that the lowest floor, including basement, is a maximum of 3 feet above the highest adjacent existing grade if the depth of the Base Flood Elevation (BFE) does not exceed 5 feet at the proposed development site. For infill sites, rehabilitation of existing structures, or redevelopment of previously developed areas, there is a 3 foot elevation requirement regardless of the depth of the BFE at the project site. The Zone AR designation will be removed and the restored flood control system shown as providing protection from the 1% annual chance flood on the NFIP map upon completion of the restoration project and submittal of all the necessary data to FEMA.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplains that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No BFE's or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.

Zone D

The Zone D designation on NFIP maps is used for areas where there are possible but undetermined flood hazards. In areas designated as Zone D, no analysis of flood hazards has been conducted. Mandatory flood insurance purchase requirements do not apply, but coverage is available. The flood insurance rates for properties in Zone D are commensurate with the uncertainty of the flood risk. Zone V Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no BFE's are shown within this zone. Mandatory flood insurance purchase requirements apply.

Zone VE
Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. BFE's derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

Zones B, C, and X
Zones B, C, and X are the flood insurance rate zones that correspond to areas outside the 100-year floodplains, areas of 100-year sheet flow flooding where average depths are less than 1 foot, areas of 100-year stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 100-year flood by levees. No BFE's or depths are shown within this zone.

2. SITE DESCRIPTION

2.1. Description of Property

The property is semiarid rangeland with a covering of desert shrub in poor condition. The site is approximately 5800 acres, all of which will be developed in residential development consisting of single-family and multiple-family residences, commercial properties, a golf course, streets, parks, and storm drainage infrastructure facilities.

The site is located within Sections 2, 3, 4, 8, 9, 10, 11, 14, 16 and 22 in Township 20 North and Range 18 West and Section 34 in Township 21 North and Range 18 West. The land generally slopes in a westerly to southwest direction at approximately 1 to 2 percent. The west side of the site is a sandy loam which becomes rockier to the east into the mountains. Shinarump Drive or County Highway 223 on the north is a graded road with drainage swales on both sides of the roadway and is occasionally depressed to grade to accommodate the existing washes flowing to the southwest. Most roads crossing the site are graded but not paved. The site is bounded on the south by Aquarius Drive.

2.2. Drainage Descriptions

Stormwater runoff originating along the western slopes Cerbat Mountains feeds several washes that impact the Golden Valley Ranch site. The Sacramento, Cerbat, and Thirteen Mile washes are the predominant waterways entering the site along the site's northern boundary. The Holy Moses Wash, entering the valley from the east along the slopes of an alluvial fan, receives its runoff from the southern slopes of the Cerbat Mountains and western slopes of the Hualapi Mountains (in the vicinity of the City of Kingman, AZ). Other runoff is generated from rainfall over the broad westerly sloping terrain of the Sacramento Valley floor, forming rivulets and small braided channels that converge into these main washes.

The Sacramento Wash drains a watershed area of approximately 134 square miles before entering the site. Two of its channels enter the project site along the northern and western

boarders of Section 8; T20N; R18W, G&SRM. The 16 square mile watershed of the Cerbat Wash enters along the western boundary of Section 4; T20N; R18W, G&SRM. Thirteen Mile Wash combines runoff from multiple tributaries, plus diverted flow from the Holy Moses wash before it enters the site along the northern boundary of Section 4; T20N; R18W, G&SRM . Total area of the Thirteen Mile Wash tributaries is approximately 56 square miles. The Cerbat Wash and Thirteen Mile Wash join near the southwest corner of said Section 4 and flow in a southerly direction to combine with the Holy Moses Wash and the Sacramento Wash south of the site.

The Holy Moses Wash travels in a westerly direction from the apex of an alluvial fan formed at the base of the southern tip of the Cerbat Mountain Range and State Hwy 66. The channel is well defined until it reaches the broad plain of the fan where surface features show multiple diversion channels and braided washes. During large flow events, a portion of the Holy Moses Wash overflows its main channel. The main diversion is to the south away from the site. Smaller flows divert to the west entering the site along its eastern boundary or combining with the Thirteen Mile Wash. The drainage shed area contributing runoff to the site is approximately 60 square miles.

3. HYDROLOGIC METHODS, APPROACH, AND CRITERIA

3.1. Design Storm and Methodology

Criteria used for this technical study is taken from Mohave County Flood Control District policy to follow guidelines and procedures outlined in the Drainage Design Manual for Maricopa County, AZ. The design storm criteria found in the manual states that the total watershed areas up to 20 square miles are evaluated as local storms using the 100-year, 6-hour precipitation values. Watershed areas ranging from 20 square miles to 100 square miles are evaluated both as local storms as described above and as general storms which use a set distribution and 100-year, 24-hour precipitation. The larger watersheds (greater than 100 square miles) are evaluated under the general storm criteria. Local rainfall distributions are interpolated from six distribution curves according to the relationship with the total watershed area and the precipitation is adjusted according to the area-depth ratios provided in the manual.

Mohave County has accepted a comparative study "Testing Analysis of Hydrologic Methods, Kingman Area Master Plan Update, Mohave Co., AZ that recommends that the Arizona Department of Transportation (ADOT) method (Clark unit hydrograph and Green-Ampt infiltration) be used for the hydrologic update of the Kingman Area Master Plan. Therefore, the hydrologic modeling in this report uses said methods.

The US Army Corps of Engineers' (COE) HEC-HMS (Hydrologic Modeling System) version 3.0.0 is used for drainage shed modeling. This computer model simulates the surface runoff response of a drainage basin to precipitation by representing the basin as an interconnected system of hydrologic and hydraulic components. Each component models an aspect of the rainfall-runoff process within a portion of the whole basin. This basin portion is referred to as a sub-basin. The runoff hydrographs of each sub-basin are then combined and a final discharge hydrograph is obtained.

Parameters for shed and sub-shed development uses the sheds delineation based on the Preliminary Results from the Flood Insurance Study prepared for Mohave County Flood Control District, dated October 2005 (Preliminary FIS Study) and topographic mapping provided by All Topo Maps version 7. Precipitation values for the design storms are developed using the National Oceanographic and Atmospheric Administration (NOAA) Atlas 14. Soil data is taken from the National Resources Conservation Service (NRCS) Soil Data Mart for Mohave County. Green-Ampt soil parameters come from the ADOT Highway Drainage Design Manual – Hydrology.

HEC-RAS, another program from the COE is used to help determine the flow lost to upstream channel diversions within the Holy Moses Wash (upstream of the project boundary). It also provides a steady state flow analysis to determine water surface elevations within a defined channel and therefore is used to determine the Base Flood Elevation along the Holy Moses Wash Diversion 1.

3.2. Approach to the Holy Moses Wash Diversion Channel Analysis

COE's programs were used to establish peak discharge (HEC-HMS) and to analyze flow characteristics within the channel sections (HEC-RAS). HEC-RAS is used to determine the probable flow characteristics and capacity of the three major diversion washes leaving the main Holy Moses Wash channel. The area under consideration is approximately 18,000 feet of the upper most reach of the wash as it leaves the fan apex. The three diversion washes are located at approximately 1,700 ft, 10,400 ft, and 13,700 ft downstream of the apex and are identified respectively as Diversion Washes 3, 2, and 1.

Surface topography was obtained from aerial survey information and a digital terrain surface was generated. Cross-sections for the HEC-RAS analysis was generated from the digital surface and input into the model. Cross-sections were spaced at 250 ft intervals along the washes' main channel. Cross-sections were also developed for each of the three diversion channels.

Within the majority of the model's cross-sections, many of the sub channels and surface irregularities were blocked (program's obstruction capability) to force runoff into the main and secondary (braided) channels. This process was validated by use of an aerial photo to confirm runoff flow and the logic of flow in the secondary channels.

The model was run at the peak design flow to determine locations where runoff exceeds the main channel capacity. These locations were compared closely to the aerial photo of the wash for physical verification of diverted flow. More than three locations of out flow were observed, but they attribute to mainly minor losses of runoff and in many instances returned to the main channel. These secondary channels returning to the main channel were not reviewed.

The water surface elevations from the models output summary report were compared to the channel bank elevation. Where the water surface exceeded the bank elevation, runoff spills out of the main channel and into either a secondary channel or leaves the wash in one of the diversion washes. Again, this was verified with the aerial photo. The amount of runoff flow leaving the Holy Moses Wash was determined from the program's channel report and removed

from additional downstream computation through a diversion in the HEC-MHS input file. This became an iterative process between the two COE programs.

3.3. Drainage Sheds

Mohave County provided the Preliminary FIS Study and delineations for those basins developed for this study were accepted. Shed parameters developed for the Preliminary FIS Study were developed using SCS methods and criteria. Therefore, modifications were made to the soils, time of concentration, and shed storage values to reflect Green-Ampt and Clark Hydrograph methods.

New drainage basins to complete the needed analysis were delineated from the US Geological Survey 1:24000 scale Quad Maps for Arizona. Drainage through Rhodes Parcels and the Holy Moses wash area from I-40 to the project site was verified from 2-foot aerial topography.

3.4. Soils

Soil type was identified by its texture as identified on the NRCS soil's map. Composite values bases on ADOT methodology were then input into the HEC-HMS program. Normally, soils of desert cover are considered "dry", where irrigated soils are "normal". The drainage basins were identified to have a typical desert type land use. This was included within default parameters of the program and pre project conditions were determined to be "dry". Infiltration losses were calculated using the Green and Ampt methods.

The Green and Ampt equation for determining loss from surface infiltration and the surface retention losses are determined for input into the HEC-HMS program. Typical values for the Volumetric Soil Moisture Deficit (DTHETA), Hydraulic Conductivity (XKSAT), and Capillary Suction (PSIF), based on the soil texture are shown in Table 2.

Table 2 – Typical Green-Ampt Infiltration Parameters (from ADOT Table 3-2)

Soil Texture	DTHETA			XKSAT	PSIF
	Dry	Normal	Saturated	In/hr	Inches
Sand	0.35	0.30	0	4.6	1.9
Loamy Sand	0.35	0.30	0	1.2	2.4
Sandy Loam	0.35	0.25	0	0.4	4.3
Loam	0.35	0.25	0	0.25	3.5
Silt Loam	0.40	0.25	0	0.15	6.6
Silt Loam	0.35	0.15	0	0.1	7.5
Sandy Clay Loam	0.25	0.15	0	0.06	8.6
Caly Loam	0.25	0.15	0	0.04	8.2
Silty Clay Loam	0.30	0.15	0	0.04	10.8
Sandy Clay	0.20	0.10	0	0.02	9.4
Silty Clay	0.20	0.10	0	0.02	11.5
Clay	0.15	0.05	0	0.01	12.4

Surface Retention Loss (IA) is used with the Green-Ampt Infiltration Equation to estimate rainfall losses. It is a function of land use, surface cover, and slope. Existing conditions assume

natural land use in a desert and mountainous environment. The slopes used are the hydraulic slope of the drainage shed and not a weighted slope. Generally, the slope is less than 5% across the total shed length and therefore, the IA valued though out the model is 0.35. Table 3 provides the typical IA values used in the Green-Amp Infiltration Equation.

Table 3 – Surface Retention Loss for Natural Surfaces (taken from Maricopa Table 3-1)

Land Use Category	Description	IA (inches)
Undeveloped Desert Rangeland	Little topographic relief, slopes < 5%	0.35
Hillslopes, Sonoran Desert	Moderate topographic relief, slopes > 5%	0.15
Mountain Terrain	High topographic relief, slopes > 10%	0.25

Each soil group or association is comprised of multiple soil textures have individual Green-Ampt parameters. The soil group is weighed based on the percent of soil textures and the confining layer within the upper 6-inches of the ground surface. The soil texture with the most restrictive hydraulic conductivity (XKSAT) is assigned as the predominant soil. A composite XKSAT is based on its percentage of the soils types over the total area of the drainage shed. Composite values for the individual drainage sheds are presented in the Table 4. The Dtheta and PSIF are composite values based on Figure 3-3 of the ADOT Drainage Manual.

Table 4 - Soil Characteristics

BASIN_TXT	Area (sq mi)	Dtheta	PSIF	XKSAT
13MileWash-01	0.0215	0.35	4.8	0.27
13MileWash-02	0.7827	0.39	5.8	0.16
13MileWash-03	1.5852	0.38	5.4	0.20
13MileWash-04	4.2919	0.35	4.9	0.26
13MileWashA-01	1.2028	0.39	5.6	0.17
13MileWashA-02	4.8114	0.38	5.5	0.18
13MileWashB-01	0.4188	0.36	5.2	0.23
13MileWashB-02	0.0570	0.37	5.4	0.21
13MileWashB-03	0.3592	0.39	5.8	0.16
13MileWashB-04	0.0449	0.35	4.1	0.38
13MileWashB-05	6.4185	0.37	5.4	0.21
13MileWashB-1A-01	0.5987	0.40	6.2	0.15
13MileWashB-1A-02	0.1641	0.35	7.0	0.11
13MileWashB-1A-03	0.1314	0.32	7.5	0.09
13MileWashB-1B-01	0.0439	0.37	6.6	0.12
13MileWashB-1B-02	0.0675	0.35	7.2	0.10
13MileWashB-1C-01	0.1147	0.35	7.0	0.10
13MileWashB-1C-02	0.0593	0.36	5.2	0.22
13MileWashC-01	0.0375	0.35	4.2	0.37
13MileWashC-02	1.7953	0.39	5.8	0.16
13MileWashC-03	1.1533	0.39	5.8	0.17
13MileWashC-04	5.3401	0.35	4.5	0.30
13MileWashCmisc-01	13.8253	0.35	4.6	0.28
13MileWashCmisc-02	11.6593	0.35	5.0	0.24
Cerbat-01	0.9269	0.40	6.2	0.14
Cerbat-02	3.6691	0.38	5.5	0.18

BASIN_TXT	Area (sq mi)	Dtheta	PSIF	XKSAT
cerbat-03	10.0830	0.36	5.0	0.23
CerbatTrib1A-01	0.5285	0.35	7.2	0.10
CerbatTribA-02	0.8467	0.39	5.8	0.17
SacTrib6-01	0.0269	0.35	4.2	0.36
SacTrib6-02	0.0516	0.35	4.5	0.31
SacTrib6-03	0.2335	0.36	5.2	0.22
SacTrib6-04	0.4200	0.36	5.0	0.24
SacTrib6-05	19.5342	0.37	5.4	0.20
SacTrib6C-01	0.2913	0.305	7.9	0.08
SacTrib6C-02	0.1827	0.29	8.4	0.06
SacTrib6C-03	0.2074	0.305	7.9	0.08
SacTrib6C-04	0.2518	0.32	7.5	0.08
Sactrib6D-01	0.2913	0.27	8.2	0.06
SacTrib6D-02	0.4351	0.27	8.2	0.06
SacTrib6misc-01	0.6352	0.29	8.4	0.06
13MileWashE-03	0.3570	0.35	4.1	0.40
MolyMosesA-02	1.2132	0.35	4.9	0.25
HolyMosesA-03	3.8747	0.35	4.4	0.33
HolyMosesA-04	7.8524	0.39	5.8	0.17
HolyMosesA-05	4.2697	0.35	4.3	0.34
HolyMosesA-07	13.3273	0.35	4.4	0.31
Offsite Diverted-01	1.1335	0.36	5.2	0.23
Offsite Diverted-02	0.1161	0.37	5.3	0.21
SacWashA-02	4.8070	0.40	6.2	0.14
SacWashA-03	0.4226	0.40	6.0	0.15
SacWashA-04	2.1252	0.35	7.2	0.10
SacWashA-05	3.2534	0.32	7.5	0.08
SacWashA-06	1.0804	0.39	6.4	0.13
SacWashA-07	9.8410	0.36	6.8	0.12
HolyMosesA-06	8.1490	0.40	6.0	0.15
SacWashA08	5.1930	0.305	7.9	0.07
HolyMosesA-04	8.2644	0.39	5.8	0.17
SacWashA-09	10.2545	0.37	6.6	0.13
SacWashA-10	2.7732	0.39	6.4	0.14
SacWashA-11	13.9298	0.305	7.9	0.07
SacWashA-12	18.2356	0.40	6.0	0.15
SacWashB-01	5.3076	0.39	6.4	0.14
SacWashC-01	10.3994	0.38	5.4	0.20
SacWashC-02	9.6297	0.35	4.9	0.26
SacWashD-01	14.1515	0.39	5.8	0.16
13MileWashE-01	1.0617	0.305	7.9	0.08
HolyMosesA-08	19.2803	0.40	6.0	0.16
SacWashE-01	2.0957	0.35	5.0	0.25
HolyMosesA_01	3.2959	0.35	4.1	0.39
SacWashA_01	4.4406	0.35	4.5	0.30
13MileWashD_02	1.9345	0.35	4.1	0.40

3.5. Precipitation

As rainfall comes to the Golden Valley, precipitation values are not uniform over the study area. Heavier amounts of rainfall are observed in the higher elevations of the mountains and taper off into the valley. The data base from the National Oceanographic and Atmospheric Administration (NOAA) Atlas 14 is used to weigh the precipitation values for the 100-yr, 6-hr (local) and 100-yr, 24-hr (regional) storm events.

Weighted precipitation depths for the drainage sheds range from approximately 4.15-inches to 4.39-inches for the 100-yr, 24-hr storm and 2.98-inches to 3.19-inches for the 100-yr, 6-hr storm.

Depth-area reduction factors were applied to the HEC-HMS modeling to distribute or average the rainfall depth over the large drainage shed. These factors were interpolated from Tables 2.1 and 2.2 of the Drainage Design Manual for Maricopa County, Hydrology Volume, Chapter 2-Rainfall.

3.6. Shed Routing

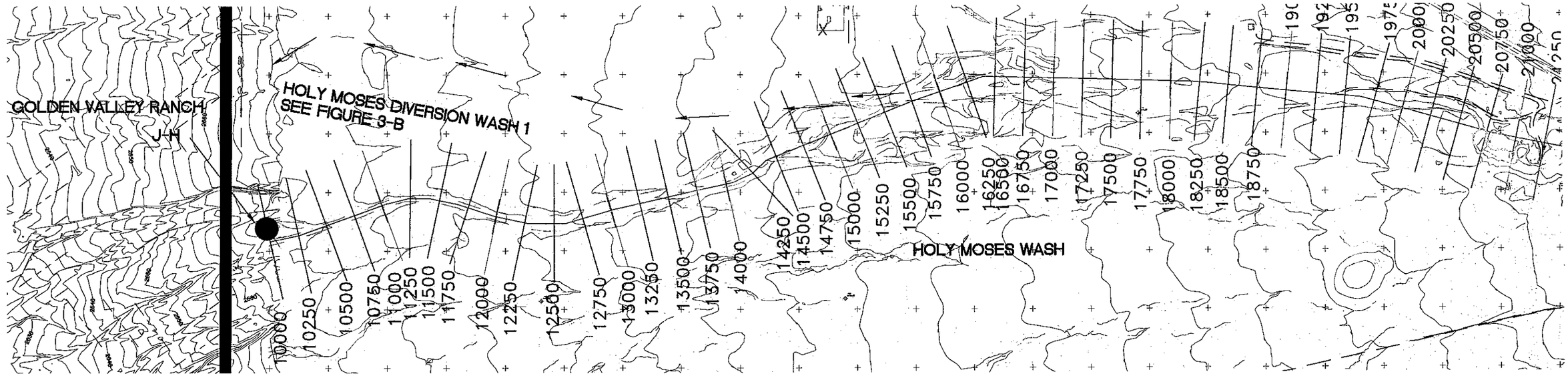
Runoff routing within the drainage shed assumes that an element of precipitation from the most hydrologic remote area drains downward to the lowest limit of the shed. Since the slopes within the shed are generally steeper in the upper reaches of the shed than at the lower limit, slope averaging as presented in the ADOT drainage manual was used.

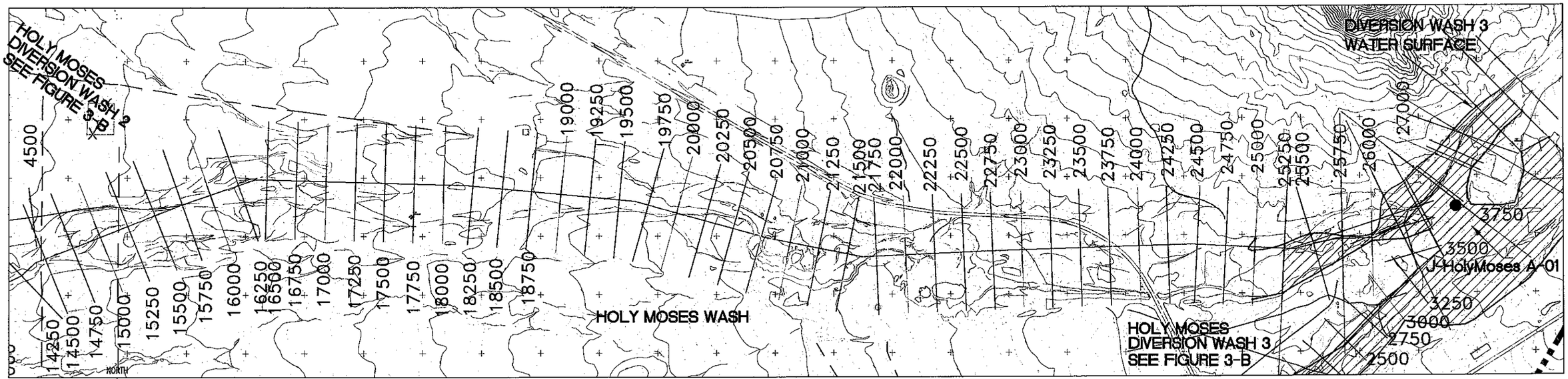
Routing runoff from a shed to a point of concentration or junction is accomplished using Muskingum methods, assuming a wide, shallow rectangular channel. This allows for some attenuation and storage of runoff. The Preliminary FIS utilized Mustingum-Cunge methods in runoff routing. These were not modified for those Preliminary FIS areas.

3.7. Model Results for Regional and Holy Moses Diversion Analyses

This study develops points of concentration at the peripheral boundaries of the site and at confluences of the major washes (points A-Q). Runoff values for the 100-yr, 24-hr and the 100-yr, 6-hr rain events are presented in Table 5. HEC-HMS model results for existing and developed areas are in Appendix B.

Junction point J-HolyMosesA-01 is located at the alluvial fan apex and upstream of the Holy Moses Diversion 3. The location of the Holy Moses Wash diversion channels are indicated on Figures 3A & 3B – Holy Moses Wash Diversion Washes and the results of the HEC-RAS analyses are shown in Table 6.





NORTH

GRAPHIC SCALE

2000 0 1000 2000 4000 8000

(IN FEET)
1 inch = 2000ft.

HOLY MOSES WASH HEC-RAS GENERAL STORM ANALYSIS
(100yr., 24 hr PRECIPITATION)

LOCATION (STATION)	DESCRIPTION	MAIN CHANNEL (CFS)	DIVERSION (CFS)
277+50	APEX (J-HolyMosesA-01)	9,904	0
260+00	UPSTREAM	9,904	0
	DIVERSION 3	5,229	4,373
175+00	DIVERSION 2	4,141	1,088
140+00	DIVERSION 1 (J-H)	4,030	111

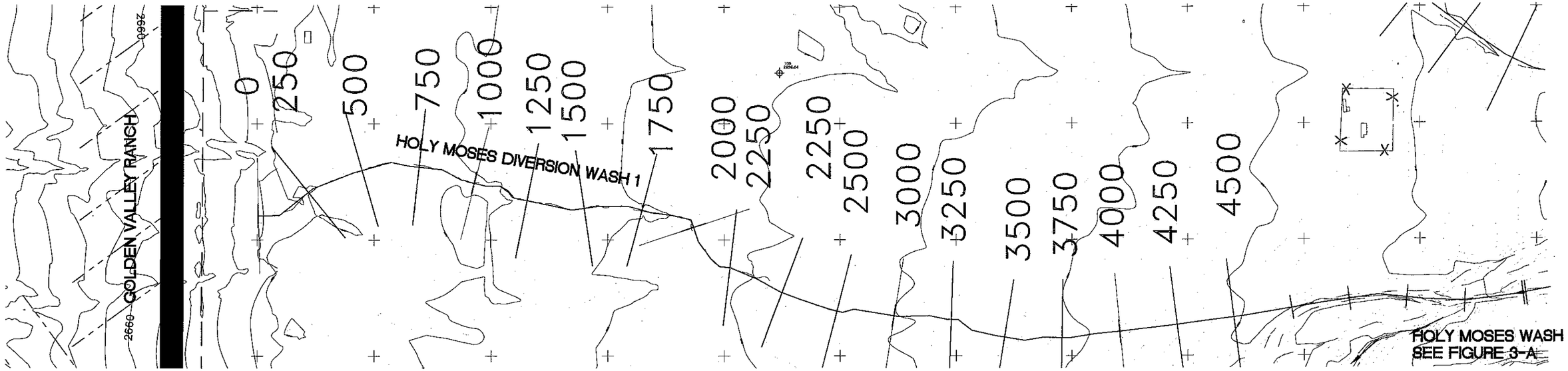
HEC-RAS CROSS-SECTIONS SHOWN

LEGEND:
- PROJECT BOUNDARY
- FEMA FLOOD PLAIN
- DRAINAGE SHED BOUNDARY
- DRAINAGE SUB-SHED BOUNDARY

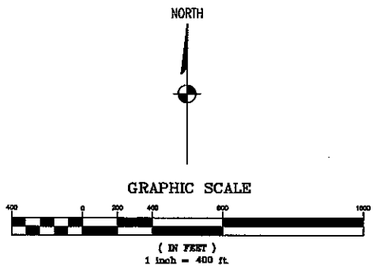
Stanley Consultants INC.
5820 S. EASTERN AVENUE, SUITE 200
LAS VEGAS, NEVADA 89119 (702) 369-9396

GOLDEN VALLEY RANCH
HOLY MOSES WASH & DIVERSION WASHES
TECHNICAL DRAINAGE STUDY EXHIBIT

MOHAVE COUNTY ARIZONA FIGURE 3-A



HOLY MOSES DIVERSION WASH 1

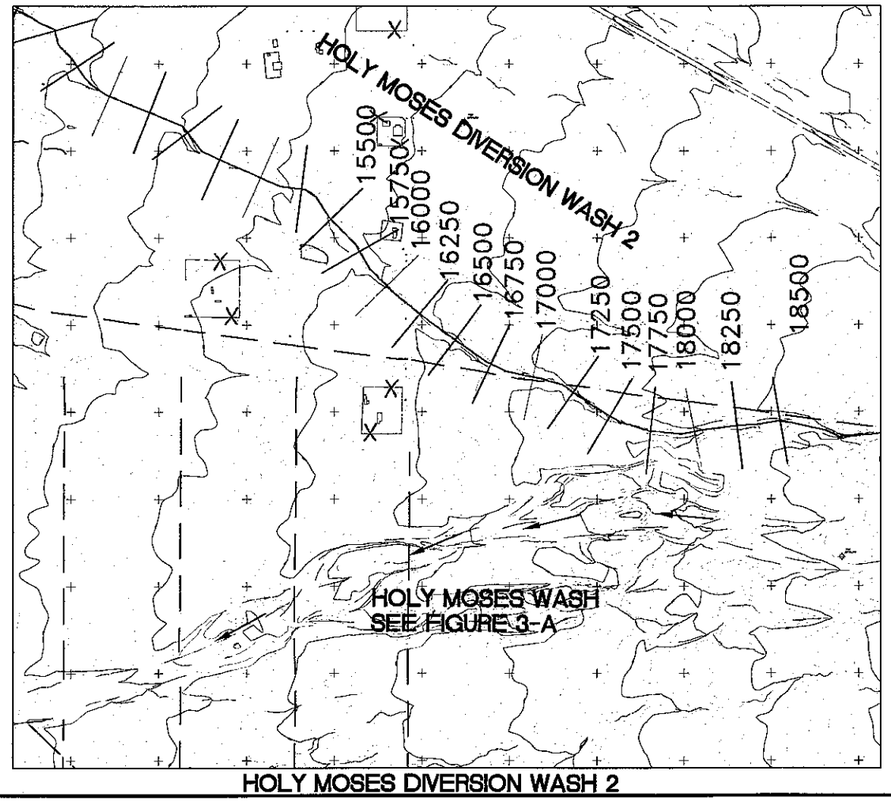


HOLY MOSES WASH HEC-RAS GENERAL STORM ANALYSIS
(100yr., 24 hr PRECIPITATION)

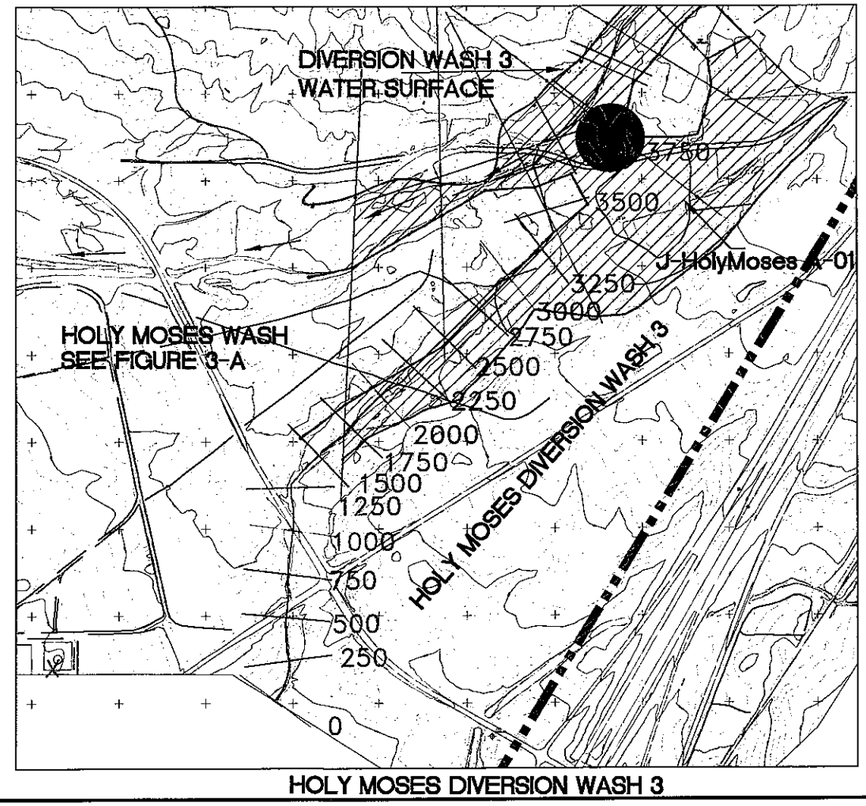
LOCATION (STATION)	DESCRIPTION	MAIN CHANNEL (CFS)	DIVERSION (CFS)
277+50	APEX (J-HolymosesA-01)	14,563	0
260+00	UPSTREAM	14,563	0
	DIVERSION 3	5,244	9,319
175+00	DIVERSION 2	4,141	1,103
140+00	DIVERSION 1 (J-G)	4,030	111

HEC-RAS CROSS-SECTIONS SHOWN

LEGEND:
- PROJECT BOUNDARY
- FEMA FLOOD PLAIN
- DRAINAGE SHED BOUNDARY
- DRAINAGE SUB-SHED BOUNDARY



HOLY MOSES DIVERSION WASH 2



HOLY MOSES DIVERSION WASH 3

Stanley Consultants INC.
5820 S. EASTERN AVENUE, SUITE 200
LAS VEGAS, NEVADA 89119 (702) 369-9396

GOLDEN VALLEY RANCH
HOLY MOSES WASH & DIVERSION WASHES
TECHNICAL DRAINAGE STUDY EXHIBIT

MOHAVE COUNTY ARIZONA FIGURE 3-B

Table 5 – Regional Shed Analysis Results

		Design Storm (cfs) [1]	
Point/Junction	**Area**	**100-yr, 24-hr**	**100-yr, 6hr**
A	134.0	13,980	
B	1.1		390
C	71.0	12,500	6,230
D	16.9	3,020	1,870
E	20.0	3,940	2,710
F	13.8		5,720
G	0.4	230	
H	58.4	4,120	4,070
J	2.1		1,120
K	0.1		140
L	1.1		730
M	72.8	15,560	11,780
N	134.5	11,950 [2]	
Q	275.0	21,490	

1 – Runoff values are rounded to the nearest 10 cfs

2 – Peak flow at N (downstream of M) is lower due to system timing. M peaks at 16:00 and N peaks at 16:55.

Table 6 – Diversion Channel Analysis for the Holy Moses Wash

Location (Station)	Description	Regional Storm - 100-yr, 24hr (cfs)	
		Flow (Main)	Flow (Diversion)
277+50	Apex (J-HolyMosesA-01)	9,904	
260+00	Upstream	9,904	
	Diversion 3	5,229	4,373
175+00	Diversion 2	4,141	1,088
140+00	Diversion 1 (J-H)	4,030	111

4. GOLDEN VALLEY RANCH

The Golden Valley Ranch project will be developed into a residential community consisting of single-family (7,000 square feet lots) residences, streets, and open spaces. The initial phases of the developed master planned project consists the construction of the premier golf course and three development areas.

The projects are situated between the Thirteen Miles Wash and the Holy Moses Wash. Small braided channels traverse the site and a diversion channel from the Holy Moses Wash (Diversion Wash 1) crosses in a southwesterly direction across the site. The project lies on westerly sloping alluvial fan originating from the Cerbat Mountains.

Early grading is centered on development of the golf course, associated amenities, adjacent residential areas (Areas 1-3), and mass grading area (spoils storage & future Areas 43 & 44). It is proposed that the golf course will be constructed sunken, below natural grade and the excess material will be used to elevate the residential communities above natural grade (See Figure 4 – Golden Valley Ranch).

Detailed technical studies have been prepared for each of the development areas with only a short description of the drainage characteristics and modeling results of these studies is presented here. Figures showing the Area storm drain infrastructure and routing through the developments and golf courses, as well as a summary of the resultant runoff are provided in Appendix D. Additional analysis of the individual Area development is provided in the technical drainage study for each Area.

Rainfall runoff generated within the development travels from the individual residential lot or open space to the street. The street is the main mean of runoff conveyance until runoff exceeds street capacity. When that happens, runoff is received into an underground storm drainage system, into a drainage swale or channel. The storm drainage system is sized to convey a minimum of the 10-yr, 6-hr storm runoff. Runoff generally drains in a southwesterly direction toward one of six release points. Here, it releases either into a conveyance system within the West Loop Road that is sized for the 100-yr, 6-hr precipitation or into the adjoining golf course. Eventually, all runoff is combined and discharged into the Thirteen Mile Wash, a tributary of the Sacramento Wash.

4.1. Areas 1 - 3

Proposed drainage for the projects will be conveyed within the developed street system to be released to the golf course or to conveyance channel. Ultimate release is back into the existing washes. Facility design is to the 100-yr, 6-hr storm event for channels, streets, washes, and culvert conveyance from the Areas to the golf course or traversing major streets. Conveyance pipes may be required within some streets to reduce the overland street flow to street capacity criteria (Appendix D) and are generally sized to the 10-yr, 6-hr criteria. The golf course conveyance will provide stormwater storage within its fairways and lakes. An underdrain system is provided to relieve golf course low points and as a low flow conveyance to provide positive drainage for the "bubble-up" structures. This pipe system also provides dry access through the Club House Road underpass, except during times of severe precipitation. Final disposition of runoff is to return the flow back into the natural wash.

Area 1, Phases A & B is divided into thirty-eight small sub-sheds, ranging in size from 1.1 acres to 11.5 acres. Shed P1-83 discharges to the north into the golf course and runoff and is conveyed with Area 2 flows. Approximately 13.4 acres collects at junction J-C14, discharges under the West Loop Road and is conveyed in a pipe system within the roadway. An open space bisects Area 1 and is utilized for drainage runoff collection and conveyance. Approximately 88 acres of runoff is collected and conveyed by this open space to J-C26. Here it drains in a culvert under the West Loop Road and combines with J-C14. The flow then continues in a southwesterly direction, adjacent and parallel to the West Loop Road. The southern portion of Area 1 and within Phase 2 is collected at two points, J-C17 and J-C21 and drains into the West Loop Road

stormwater collector. J-C17 drains approximately 35 acres and discharges into the collector midway between Area 1 open space drain and H Street. J-C21 enters the collector at H Street and serves approximately 17 acres. The most southerly portion of Area 1, Phase B collects at J-C25 and discharges into the adjacent golf course via a bubble-up structure and low flow drain line.

Area 2, Phases A & B is divided into thirty-seven small sub-sheds, ranging in size from approximately 1 acre to 13 acres. The sunken golf course encompasses the Area 2 development. Shed P2-67 discharges into the south leg of the golf course and travels south away from the site. The remaining 192.38 acres drain west in a westerly direction into the golf course at five points. Four of theses discharge into the west leg of the golf course (between Areas 1 & 2) and flow in a northerly direction to a culvert under the West Loop Road (south of the intersection of West Loop Rd and B2 Street). The other release point drains into the north leg of the golf course (paralleling West Loop Rd.), combining with runoff from Area 3, Shed P3-44 and future Areas 61 and 62. All releases into the golf course are through bubble-up structures with low flow drains tied into the golf course underdrain system. The fairway provides conveyance for major runoff and also storage to retard the peak flow. Runoff exits the golf course via a culvert under the West Loop Road and is conveyed to the Thirteen Mile Wash through an open channel.

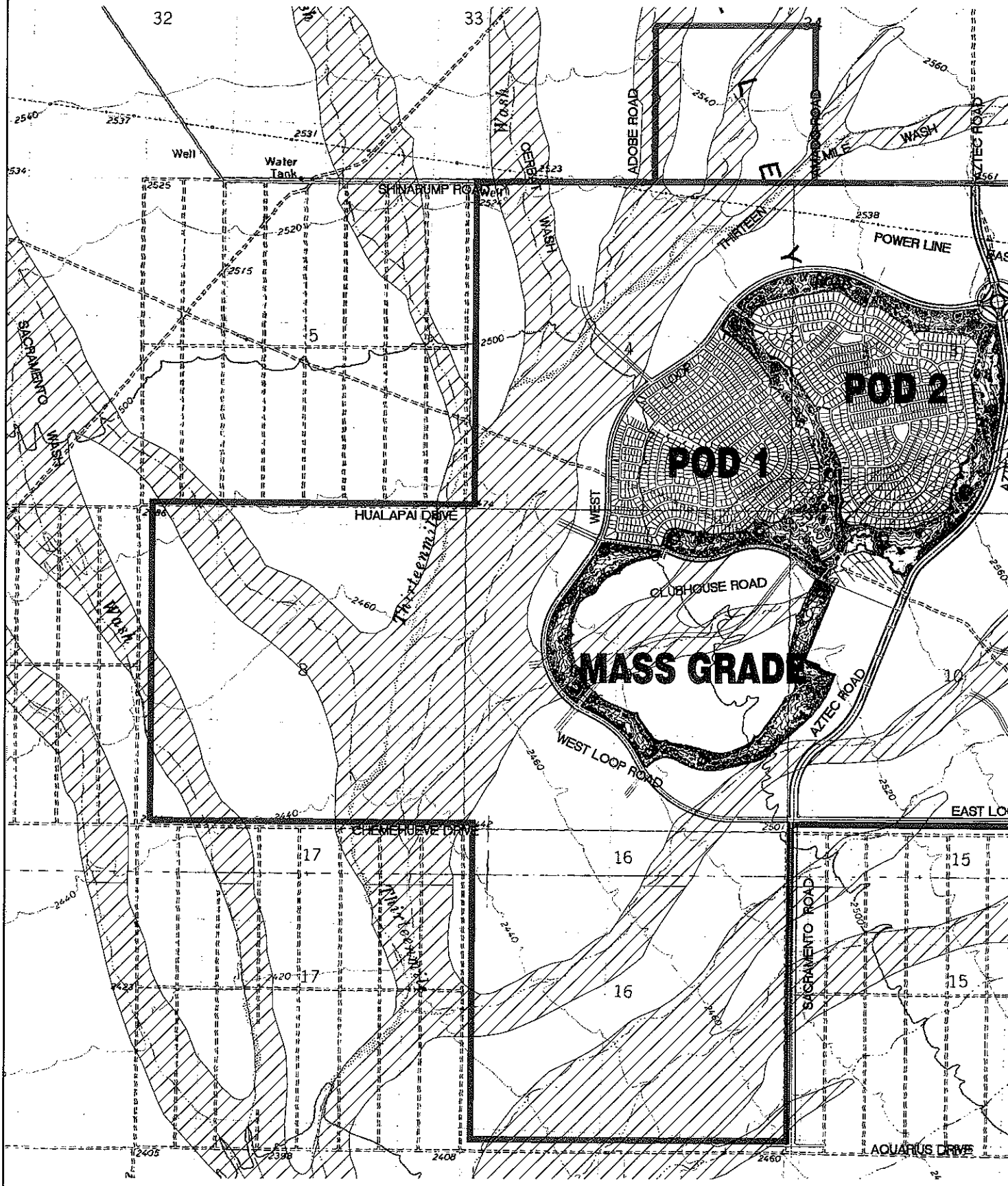
Area 3 is divided into five small sub-sheds, ranging in size from 1.6 acres to 25.4 acres. Runoff from Shed P3-44 (25 acres) discharges to the north into the golf course where it combines with runoff from Area 2 development and future Areas 62 and 63. A small shed (Shed P3-45) comprises of the Area 3 access from East Loop Road is approximately 1 acre and drains to the north where it combines with the East Loop Road drainage. The remaining 63 acres (P3-43, 50, and 60) combine at junction J-S5. Street flow from the three sub-sheds exceeds the street capacity at the intersection where it is received into a storm drainage system. The majority of flow is carried under Aztec Road and enters the golf course via a bubble-up structure. A small low flow pipe is connected to the golf course drainage system to maintain positive drainage at all times. An overland release is provided for runoff not received into the drainage system at J-S5 and enters Aztec Road.

The West Loop Road stormwater collector crosses under the roadway south of the Area 1 southerly boundary and enters the golf course, combining with upstream flow from Area 3, Area 2, and future Areas.

4.2. Methodology

Again the HEC-HMS model was used for the simulation of flood events in the Areas watersheds. In this model the SCS methods are used which add conservatism to the study and infrastructure design.

HEC-RAS, another program from the COE, provides a steady state flow analysis to determine water surface elevations within a defined channel or flood plain. Volume computations within the HEC-RAS program were utilized in developing flow routing by Modified-Puls methods for routing through the golf course fairway system.



Stanley Consultants INC.
5820 S. EASTERN AVENUE, SUITE 200
LAS VEGAS, NEVADA 89119 (702) 369-9396

Q:\18449\Drainage Study\Exhibits\Figure 4A - Local Drainage.dwg, 6/1/2006 11:55:37 AM, \\vg-ps1\hp5500-tr-ps

4.3. Drainage Shed and Modeling Convention

The basic naming convention of the basins for the exhibits and model are based around the individual drainage shed of the development. Sheds are labeled as P1-34, identifying Area 1, Shed 34. Junction points or points of runoff confluence are identified as J-C12, identifying that it is a junction point and a label. An R designates a routing of a shed or junction, therefore R-JN15 represents routing of junction JN15 to another point.

4.4. Design Storm and Precipitation

Local jurisdiction requires that water sheds less than 20 square miles be evaluated for the 6-hour local storm. Drainage sheds of 20 to 100 square miles are to be evaluated for both the 6-hour and 24-hour rainfall events. Areas from 20 square miles to 500 square miles are considered general storms and are evaluated for the 24-hour precipitation.

Maricopa County Flood Control District has developed storm distribution curves associated with drainage shed size. Since the total area of the individual Areas less than 1 square mile, Pattern 1 of the Maricopa County 6-Hour Mass Curve was utilized for the storm distribution. Precipitation values of 3.00-inches and 1.76-inches were taken from the National Oceanographic and Atmospheric Administration National Weather Service's Atlas 14. Table 7 provides the precipitation values from NOAA Atlas 14. Since the total area of Area 1 is 0.29 square miles (187 acres) the depth-area reduction factor was not applied.

Table 7 - Precipitation

Recurrence Interval (yrs)	5 min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr
10-yr	0.40	0.61	0.75	1.01	1.25	1.44	1.53	1.76
100-yr	0.65	0.98	1.22	1.64	2.03	2.44	2.67	3.00

4.5. Soils

Soils information is taken from NRCS Soil Data Mart shows the soils as representing a Type "B" hydrologic soil. Therefore, a general Curve Number (CN) of 77 representing a natural desert landscape is used in the model.

4.6. Model Data and Results

Tables 8 summarize runoff at strategic junction points and drainage sheds within the proposed drainage system. Runoff values are rounded to the nearest 1 cfs. A full printout of the system runoff results are presented in the Appendix D.

Table 8 - Pre Development vs Post Development Runoff

GOLDEN VALLEY RANCH

Existing Sheds	Area (sq mi)	Existing Runoff (cfs) [1]	Shed/Junction	Area (sq mi)	Developed Runoff (cfs)
J-H	0.1330	211	J-H	0.1147	228
EX-1	0.3927	446			
			P3-44	0.0281	49
JN-5	0.5257	545	JN-5	0.5421	729
EX-3	0.3792	435			
EX-2	0.5193	541			
EX-4	0.5665	574			
			J-S5	0.1092	184
			Areas 10&11	0.2440	347
			Area 12	0.0637	154
			Area 13	0.0527	162
			J-S9	0.6705	459
J-S26	0.9063	794	J-S26	0.9465	799
J-MG-1	1.4672	1,107	J-MG1	1.4525	995

[1] Flow calculated from ADWR Region 10 regression equation $Q = 850A^{0.69}$

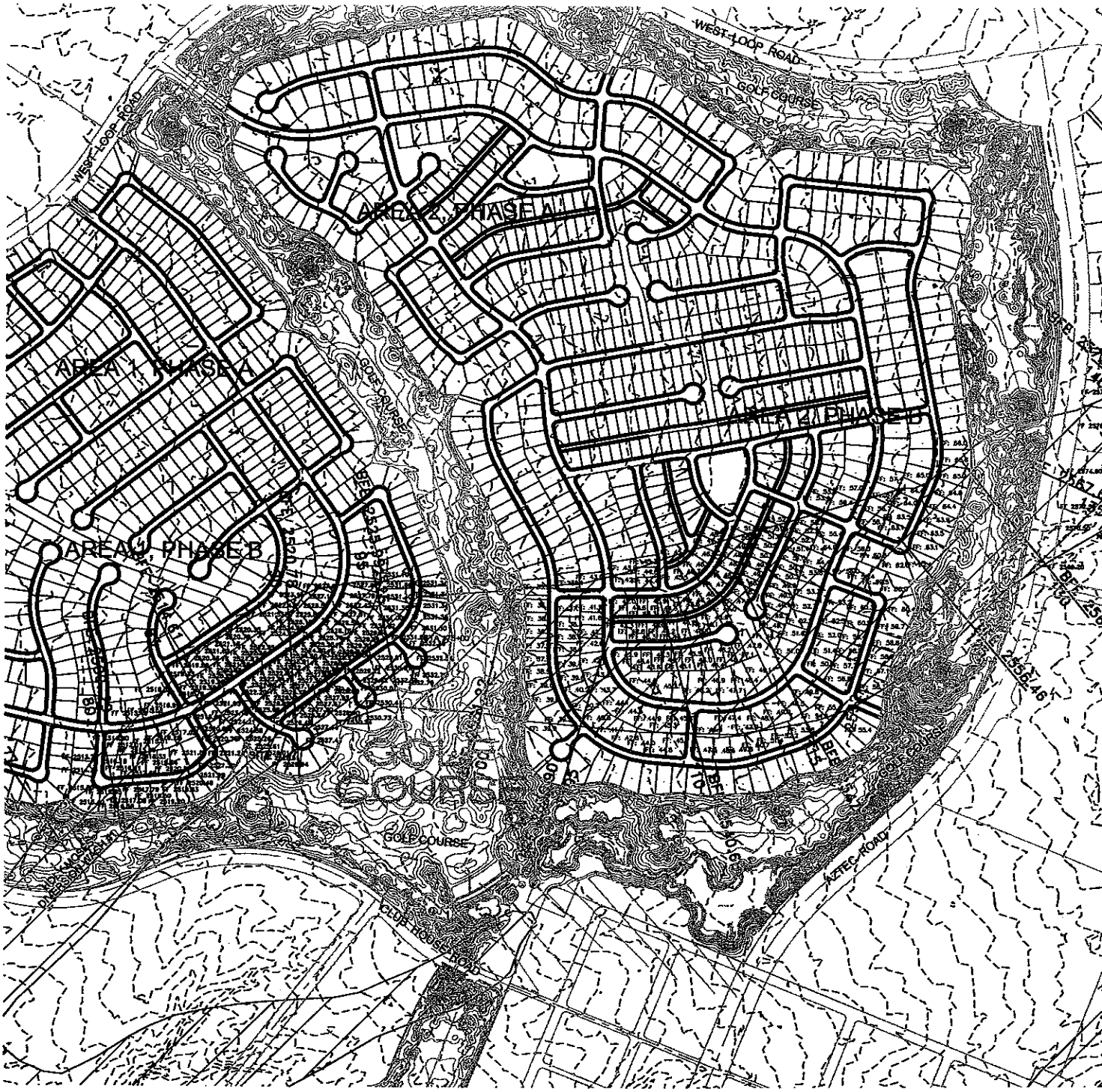
Stanley Consultants INC.
5820 S. EASTERN AVENUE, SUITE 200
LAS VEGAS, NEVADA 89119 (702) 369-9396

Q:\18449\Drainage Study\Exhibits\Figure 5 - Existing Local Site Drainage.dwg, 6/1/2006 1:10:12 PM, \\vg-ps1\hp5500-tr-ps

5. FEMA BASE FLOOD ELEVATIONS

The Holy Moses Diversion Wash #1 leaves the main channel east of the site. It travels in a westerly direction along the westerly sloping alluvial fan. The runoff generally remains within the washes banks, but as it reaches the channel edge it spills over into the surrounding dessert plain. Overtime the cresting and release of flow along with its sediment load has formed a channel with overbanks sloping away from the channel.

A HEC-RAS analysis provides the Base Flood Elevations (BFE) for this diversion wash. Finish building grades are developed to remain 1foot to 1.5 feet above the BFE. Figure 6 shows the BFE's for development in Areas 1-3.



Stanley Consultants INC.
5820 S. EASTERN AVENUE, SUITE 200
LAS VEGAS, NEVADA 89119 (702) 369-9396

6. SUMMARY

The first section of this study provided an overview of the drainage patterns and regional analysis of runoff within the Golden Valley area of Mohave County, AZ. Generally, all flow travels to the Sacramento Wash, via the Holy Moses Wash, Thirteen Mile Wash, and Cerbat Wash. The project site is located near the confluence of these washes. A local design storm approach should be taken to address flooding issues for any development.

The second section of the study evaluated runoff from the tributary area of the Holy Moses Wash. In particular, how this wash and its several diversion washes affected the proposed project area. As shown, the main channel of the wash and the two main diversion washes (Diversion Wash 2 and 3) divert away from the project site. Diversion Wash #3 travels southward bypassing the site and Diversion Wash #2 diverts to the north, where it combines with the Thirteen Mile Wash above Shinarump Road. Diversion Wash #1 travels in a westerly direction entering the site along its easterly boundary.

The main channel travels in a southwesterly direction past the site. It cuts across a portion of the Mass Grading Area (Future Areas 43 & 44), near the proposed intersection of Aztec Road and West Loop Road). The golf course grading around this intersection and in the immediate vicinity of the Holy Moses Wash is developed not to impact or encroach into the main channel.

The third section develops specific criteria and flow for the initial grading operations for the golf course and area construction. The proposed East Loop Road and its roadside channel protect the project from surface runoff originating east of the site and the Holy Moses Diversion Wash #1. Runoff is routed through the upstream developments (Areas 2 & 3) and discharged into broad swales incorporated into the golf course landscaping. All runoff is conveyed through the project and discharged back into the natural washes.

Discharge away from the project site (@ J-N5) exceeds its pre-developed condition. Additional detention will be supplied within the golf course system, either by grading additional storage into the golf course, sizing upstream culvert crossing to allow runoff to store, or allow runoff to be detained in the west corner of the golf course, prior to leaving the site.

Runoff from the project leaving the site (@ J-MG1) has been reduced to below pre-developed conditions by storage in the routing through the golf course.

The final section of the report addresses FEMA Base Flood Elevations for the Holy Moses Diversion Wash #1 as it enters and travels through the project site. BFE's have been established along the flood plain alignment.

Appendix E provides a discharge relationship comparing indirect methods (Arizona Department Water Resources Region 10 regression equation), 100-yr Peak Discharge Relationship(ADOT Fig. 10-17), and existing runoff using Green-Ampt methods, Clark Hydrograph, and the HEC-HMS model. Runoff flows generated using Green-Ampt methods and Clark Hydrograph produced results generally greater than those from the Region 10 regression equation. As stated

in the reference material for the regression equation, the equation may overestimate peak discharges for watershed of alluvial fan/distributary flow/sheet flow areas.

7. REFERENCES

1) *Flood Insurance Rate Map*, Community Panel Number 040058 2325 C, Mohave County, Arizona, effective October 20, 2002.

2) *Highway Drainage Design Manual*, Arizona Department of Transportation, Report Number FHWA-AZ93-281, Final Report, March, 1993

3) *Drainage Design Manual for Maricopa County, Arizona*, Hydrology: Rainfall, Flood Control District of Maricopa County, November 2003

4) *Drainage Design Management System*, Users Manual, Flood Control District of Maricopa County

5) *Flood Insurance Study - Preliminary Result,* Mohave County Flood Control District, October 2005.

6) *Requirement for Floodplain and Floodway Delineatioin in Riverine Environments,* Arizona Department of Water Resources, Flood Mitigation Section, State Standard 2-96, July 1996.

APPENDIX A

RECONNAISSANCE PHOTOS

(Taken December 07, 2004)

APPENDIX A

RECONNAISSANCE PHOTOS

(Taken December 07, 2004)

The following pictures were taken December 07, 2004

Figure 1 - Twin 36" CMP's crossing Aztec south of Redwall

Figure 2 - Hill east of Aztec in Section 23

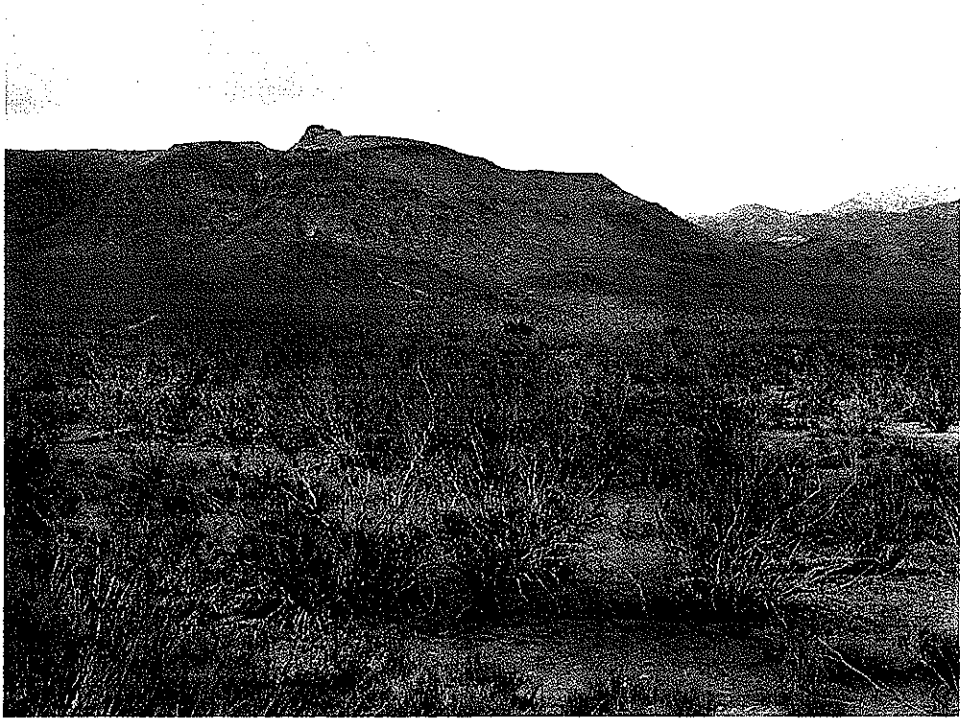


Figure 3 - From Aztec: looking SE across Section 26

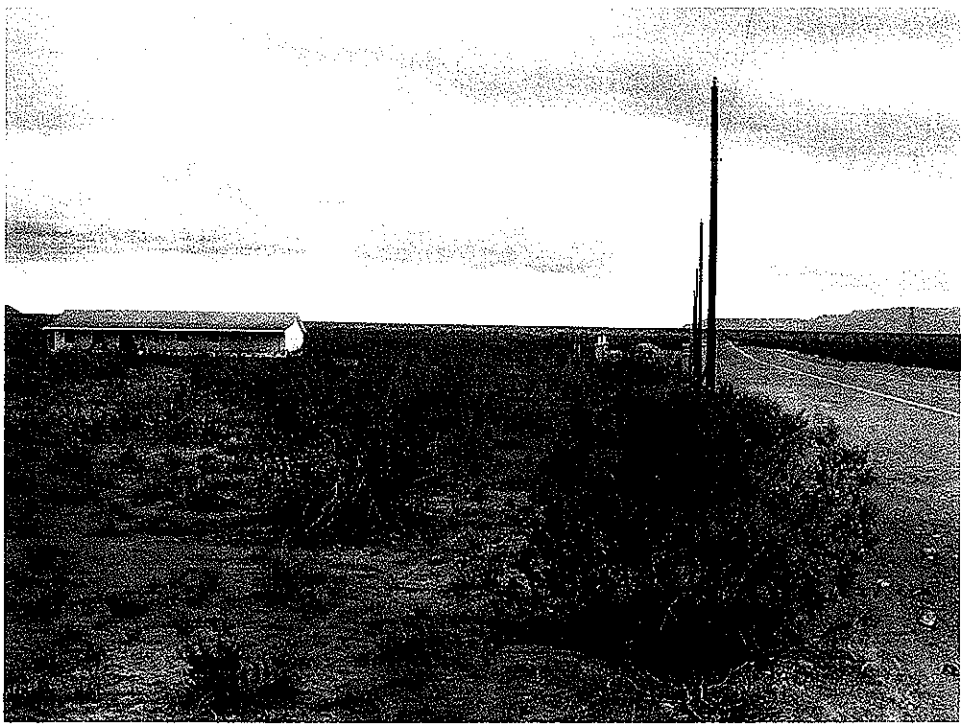


Figure 4 - "Ocean Front Ranch" - looking south along Aztec

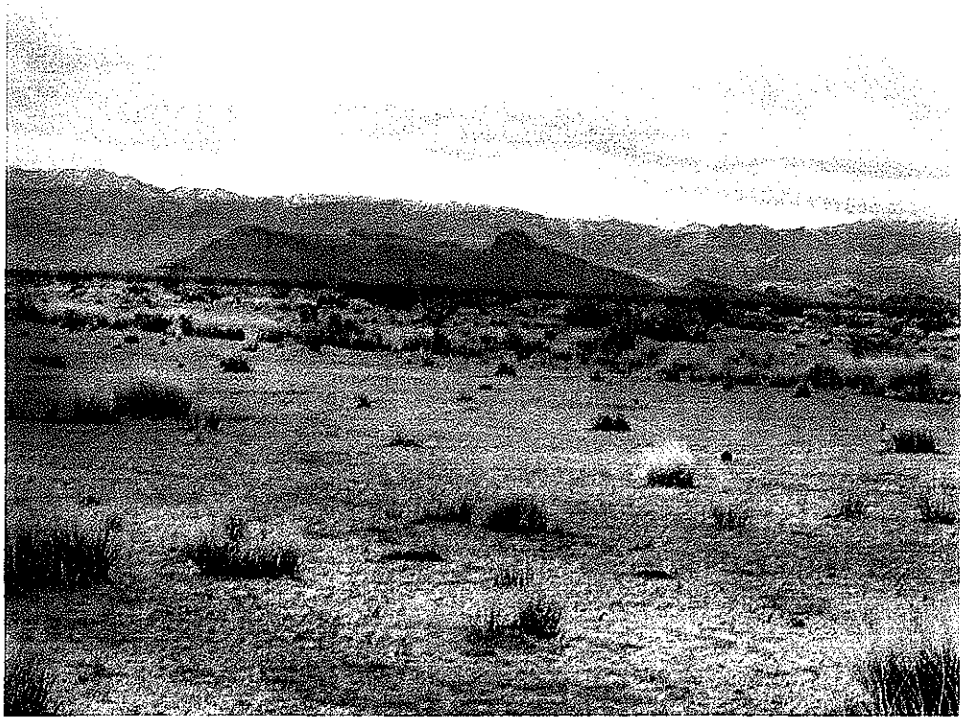


Figure 5 - NE - near Sacramento & Hualapai

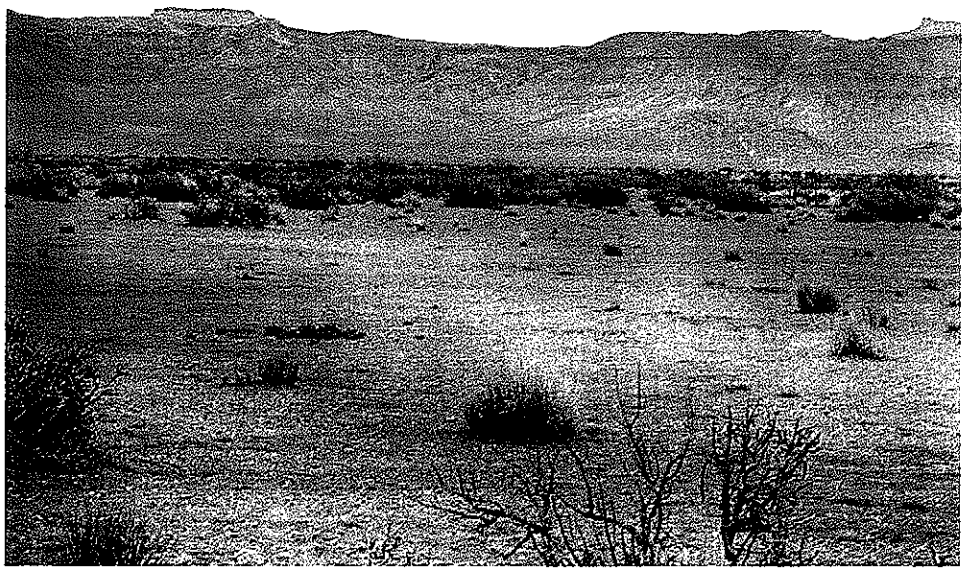


Figure 6 - SW - near Sacramento & Hualapai

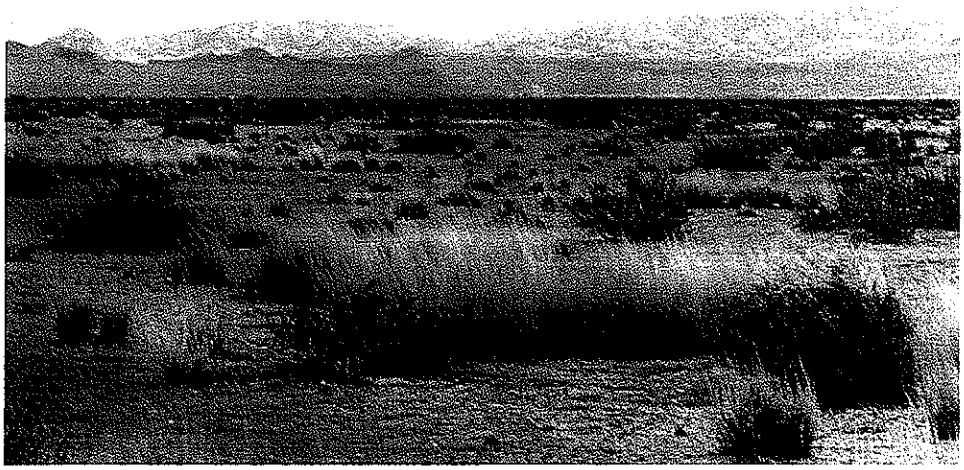


Figure 7 - SE - near Sacramento & Hualapai

Figure 8 - Sacramento Wash - south - near Acquarius

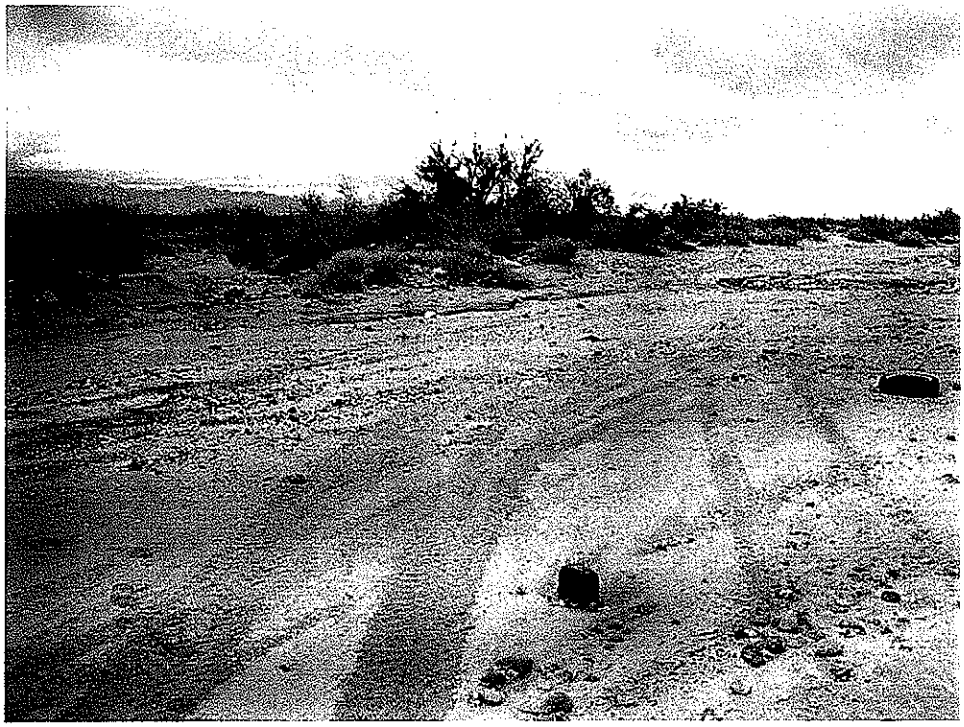


Figure 9 - Sacramento Wash - north - near Acquarius

Figure 10 - Sacramento Wash - 2nd braid north- near Acquarius

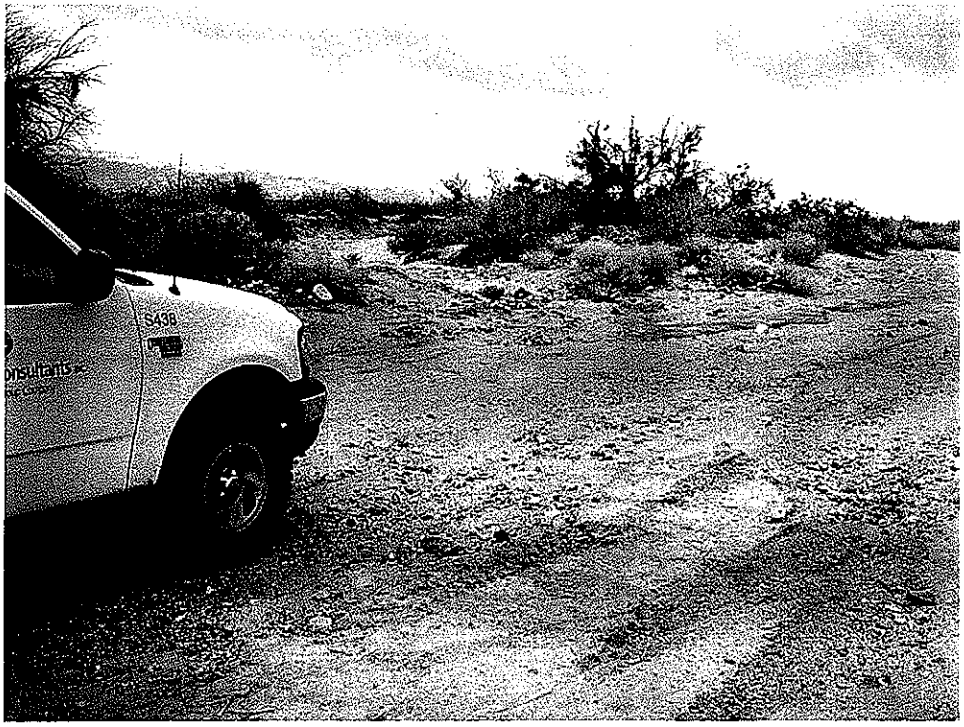


Figure 11 - Sacramento Wash - 2nd braid south - near Acquarius

Figure 12 - Sacramento Wash - 3rd braid south - near Acquarius

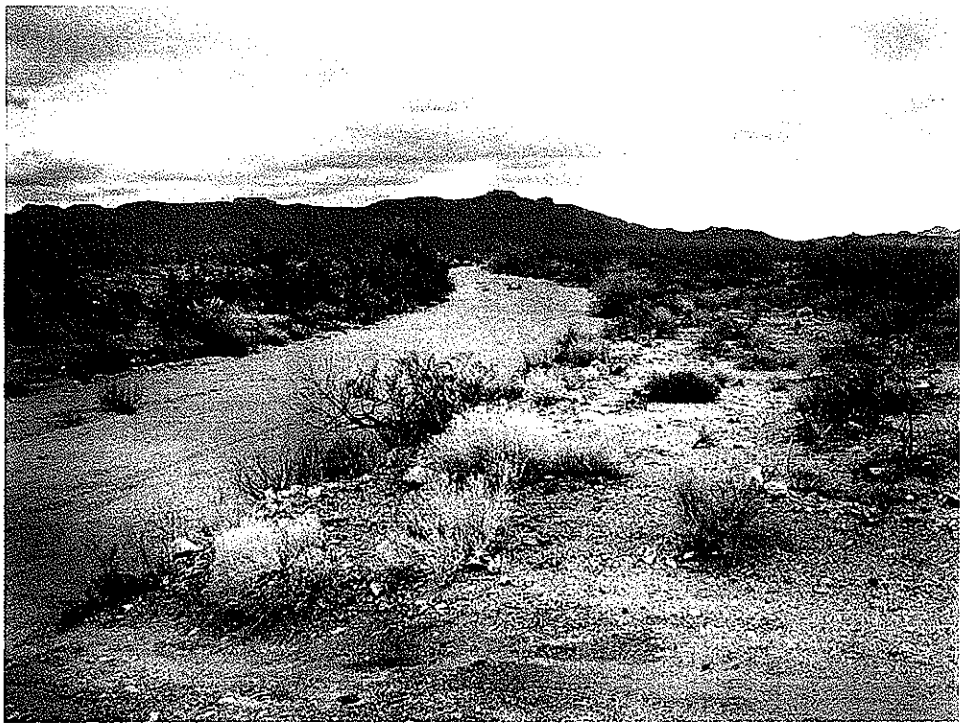


Figure 13 - E - Centennial at Holy Moses center braid

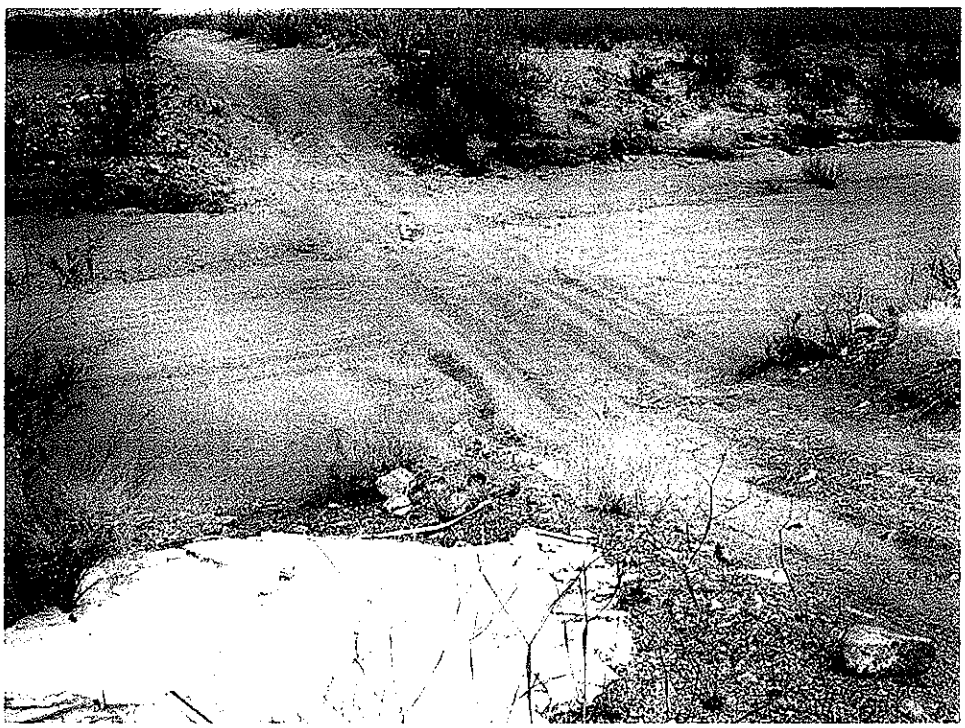


Figure 14 - Centennial at Holy Moses Wash - crossing